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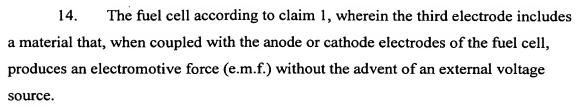
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WHAT IS CLAIMED IS:

- A fuel cell comprising;
 an anode electrode;
 a cathode electrode; and
 a third electrode interposed between the anode and the cathode electrodes.
 - 2. The fuel cell according to claim 1, wherein the third electrode is a reference electrode.
 - 3. The fuel cell according to claim 1, wherein the third electrode and at least one of the anode and cathode electrodes are coupled to an electrical apparatus.
 - 4. The fuel cell according to claim 3, wherein the electrical apparatus is a voltage or current source.
 - 5. The fuel cell according to claim 3, wherein the electrical apparatus is an electrical measurement device.
 - 6. The fuel cell according to claim 1, wherein the third electrode is used to control processes of at least one of the following: the anode and the cathode electrodes.
 - 7. The fuel cell according to claim 6, wherein the processes include at least one of the following: thermodynamic, chemical, kinetic, and transport phenomena.
 - 8. The fuel cell according to claim 1, wherein the third electrode is used to monitor the health of any component of the fuel cell.
 - 9. The fuel cell according to claim 8, wherein a component of the third electrode conducts electrons.
 - 10. The fuel cell according to claim 1, wherein the third electrode includes a material that permits ions of the electrochemical couple to be transported past, or conducted through, its interposition.
 - 11. The fuel cell according to claim 1, wherein the third electrode includes at least one of the following: a polymer and a polymer composite.
 - 12. The fuel cell according to claim 11, wherein the third electrode includes an electrically conductive component.
 - 13. The fuel cell according to claim 1, wherein the third electrode includes at least one of the following: a metallic and a polymer grid, or a conducting polymer.



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- 15. The fuel cell according to claim 1, further including at least one of the following fuel couple: substantially pure hydrocarbons, methanol, hydrazine, reformed ammonia, natural gas, and molten carbonate.
 - 16. The fuel cell according to claim 1, further including an electrolyte.
- 17. The fuel cell according to claim 16, wherein the electrolyte is a polymer solid electrolyte.
- 18. The fuel cell according to claim 16, wherein the electrolyte includes at least one of the following: a solid oxide, phosphoric acid, and alkaline.
 - 19. A method of manufacturing a fuel cell, comprising: forming an anode electrode;

forming a cathode electrode;

forming an electrolyte material;

depositing a thin film of an electrically conductive metal or conducting polymer to a reference electrode; and

sandwiching the reference electrode and electrolyte material between the anode and cathode electrodes.

- 20. The method according to claim 19, wherein the reference electrode includes a membrane.
- 21. The method according to claim 20, wherein the membrane is a polymer membrane.
- 22. A method for operating a fuel cell, comprising:

 applying an interactive feedback system to control the state of
 hydration of the ionomer membrane utilizing an electrode other than an anode or
 cathode electrode.
- 23. The method according to claim 22, wherein the interactive feedback system regulates the fuel cell.
 - 24. The method according to claim 22, wherein the interactive feedback system further monitors electrochemical processes at the anode or cathode.